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10 STEAM AND POWER CONVERSION SYSTEM

10.1 DESIGN BASIS

10.1.1 PERFORMANCE OBJECTIVES

The steam and power conversion system is designed to receive steam from the NSSS and convert the steam thermal energy into electrical energy. A closed regenerative cycle condenses the steam from the turbine and returns the condensate as feedwater to the steam generators.

The turbine generator has a rating of 774,274 KWe when operating with throttle steam conditions of 794 psia and 517.3 F exhausting at 2.5 inches Hg absolute, zero percent makeup, and six stages of feedwater heating in service.

The hydrogen inner-cooled generator is rated at 894,082 KVA at 75 psig hydrogen pressure at a power factor of 0.85.

The system design provides means to monitor and restrict radioactive releases to the environment such that 10 CFR 20 guidelines are not exceeded.

System design provides sufficient feedwater and auxiliary pumping capacity so that under conditions of loss of power and normal heat sink the required water flow to the steam generators is maintained until power is restored or reactor heat load is reduced by the residual heat removal system.

Components from the steam generators up to and including the main steam isolation valves and normal feedwater isolation valves are designed to

Seismic Class I requirements.

The main steam piping between the isolation valves and the turbine is designed to Seismic Class III requirements, as is the remainder of the components and piping.

10.1.2 ELECTRICAL SYSTEM CHARACTERISTICS

The system is designed to accept load step increases of 10% and ramp changes of 5% per minute within the load range of 15% and 100% without reactor trip subject to possible xenon limitations late in core life. Similar steps and ramp load reductions are possible between 100% and 15% load. A load rejection of 50% or less can be sustained without reactor trip with the use of steam dump to condenser.

10.1.3 FUNCTIONAL LIMITS

The system design incorporates backup methods (modulating steam dump to atmosphere and safety valves), of heat removal under any loss of normal heat sink (e.g. main steam isolation valve trip, loss of circulating water flow) to accommodate reactor shutdown heat removal requirements. The unlikely event of a steam generator tube failure is described in Section 14.2.

10.1.4 SECONDARY FUNCTIONS

The steam and power conversion system provides steam for:

a) Turbine gland seal steam
b) Reheaters steam
c) Auxiliary steam requirements
d) Air ejectors
e) Turbine driven auxiliary feedwater pumps

10.1.5 CODES AND CLASSIFICATIONS

The pressure components are designed in accordance with codes tabulated on Table 10.1-1.

TABLE 10.1-1

STEAM AND POWER CONVERSION SYSTEMS COMPONENTS

COMPONENT	DESIGN CODE
Feedwater Heaters	ASME Section VIII
Heater Drain Tanks	ASME Section VIII
Reheater Drain Tanks	ASME Section VIII
Gland Steam Condensers	ASME Section VIII
Reheater Moisture Separators	ASME Section VIII
Blow Down Tank	ASME Section VIII
Main Steam Safety Valves	ASME Section III
Piping	
Main Steam *	ASME Section I
Feedwater *	ASME Section I
Balance of Piping	ASA B31.1

* To First Isolation Valve

10.2 SYSTEM DESIGN AND OPERATION

10.2.1 SCHEMATIC FLOW DIAGRAMS

The main steam, extraction steam, condensate and feedwater, steam generator blowdown, and vent and drain systems are shown in Figures 10.2-1 through 10.2-56.

10.2.2 DESIGN FEATURES

Main Steam Systems

The main steam system is shown on Figures 10.2-1 through 10.2-10. Steam leaves each of the three steam generators through 26" O.D. lines, the three lines join outside containment in a 30" O.D. header and from this header steam flows through two 30" O.D. lines to the turbine stop valves.

(a) Main Steam Safety Valves

Safety valves are provided outside containment on each of the steam generator main steam lines. The safety valves discharge to atmosphere and are in accordance with ASME Boiler and Pressure Vessel Code, Section III.

(b) Main Steam Line Isolation

One main steam isolation valve is provided outside the containment for each main steam line from the steam generators. Each valve consists of a swing disc held open against flow by a pneumatic cylinder. A check valve is provided down stream of the isolation valve to stop reverse flow from the other two steam lines in the event of a steam break, up stream of the isolation valve.

The Main Steam Isolation Valves (MSIVs) provide safety related isolation capability for the steam generators for Main Steam Line Breaks (MSLBs) and Steam Generator Tube Ruptures (SGTRs). The MSIVs are maintained closed by the Instrument Air System. On Unit 3, a safety related nitrogen supply subsystem functions as a backup to the Instrument Air System. On Unit 4, safety related air accumulators are provided to perform this backup function. The backup subsystems consist of independent pneumatic circuits, redundant electric control solenoid valves, and dedicated high pressure gas reserves (Unit 3) or dedicated air reserves (Unit 4). This ensures that each MSIV will close in 5 seconds or less under no steam flow conditions if the Instrument Air System and one 125 VDC power channel are unavailable. These backup systems also ensure that the MSIVs will remain closed for a minimum of one hour without the need for operator action, independent of the availability of Instrument Air.

(c) Steam Dump System

The steam dump system consists of a power-operated atmospheric relief valve on each main steam line and four turbine by-pass valves which exhaust to the condenser. The total capacity of the atmospheric relief dump valves and the turbine by-pass valves is 10% percent and 27%, respectively of full power steam flow.

A nitrogen gas back-up to the air supply is provided to the steam dump to atmosphere valves with the associated hand controller in the Control Room. This N_2 system provides an alternate power source to the valves in the event of loss of all A.C. power. The N_2 system is continuously lined up with the pressure regulators set lower than normal instrument air operating pressure. One cylinder will provide sufficient capacity to the controllers to allow continuous operation of the valves for 3 hours and subsequently maintain their position for 8.5 hours. One additional cylinder is added to act as a common source for both units in the event that extended steady state operation is required.

Turbine-Generator

The turbine is a three-element, tandem-compound, four-flow exhaust, 1800 RPM unit with 45-inch last row blades. Moisture separation and live steam reheat occurs between the HP and LP elements. The generator and rotating rectifier exciter are direct-connected to the turbine shaft.

There are four, horizontal-axis, cylindrical-shell, combined moisture separator, live-steam reheater assemblies. Steam from the exhaust of the HP turbine element enters the end of each assembly. Internal manifolds in the lower section distribute the wet steam. The steam then rises through a wire mesh moisture separator where the moisture is removed. Live steam from the steam generator enters at the other end of each assembly, passes through the tubes and leaves as condensate. The lower pressure steam leaving the wire mesh separator flows over the tube bundle where it is reheated. This reheated steam leaves through openings in the top of the assemblies and flows through the intercept valves to the LP turbines.

Reheat safety valves are furnished with a minimum setting pressure of 15% above the high pressure turbine exhaust.

The turbine oil system (see Figures 10.2-11 through 10.2-14) is of a conventional design and supplies all of the oil required for the emergency trip and lubrication system during normal operation. Oil is also used to seal the generator glands to prevent hydrogen leakage from the machine. A "Bowser" type oil conditioner is used for purifying oil in the storage tank and all makeup oil before it is added to the system.

The proper conditioner level is maintained by a pneumatic level control system.

The turbine is equipped with a slow speed, motor driven, spindle turning gear which is side mounted on an outboard bearing of the low pressure turbine.

Condensate and Feedwater

The condensate system flow diagrams are shown in Figures 10.2-15 through 10.2-20, the feedwater system on Figures 10.2-21 through 10.2-28. The feedwater train is the closed type with deaeration accomplished in the condenser. Condensate is pumped from the condenser hotwell by the condensate pumps through the air ejectors, gland steam condenser and low pressure heaters to the suction of feedwater pumps. The feedwater pumps then deliver feedwater through the high pressure heaters to the steam generators. All feedwater heaters are provided with internal drain coolers except heater No. 5. The No. 1 and 2 low pressure heaters are installed in the condenser neck.

Two 60% capacity, vertical, multi-stage, pit type centrifugal heater drain pumps with vertical motor drives are provided (see Figures 10.2-32 and 10.2-38). These pumps pass collected drains from the drain tank forward to the suction of the steam generator feed pumps. The condenser is the twin shell, double flow, deaerating type with semi-cylindrical water boxes bolted at both ends. It has required manholes, a water gauge glass to indicate the condensate level and one condensate outlet per shell. Expansion joints for all circulating water inlet and outlet connections are provided. There are three 60% capacity multi-stage, vertical, pit-type, centrifugal condensate pumps with vertical motor drives. Normally only two condensate pumps are operating.

The steam-jet air ejector (see Figures 10.2-58, 59) has two first stage elements and two secondary stage elements mounted on the shell of the intermediate and after condensers. The ejector is supplied with steam from the main steam line as is the hogging ejector for the condenser steam space.

Two 60% capacity, horizontal, split case, motor-driven, constant speed, steam generator feedwater pumps are provided and each is equipped with minimum flow protection devices. The design discharge pressure is the required steam generator pressure plus feedwater system losses to include feedwater heaters, piping and valves, feedwater regulator plus static head allowance.

Circulating Water System

The circulating water system is designed to provide water from the canal, regardless of weather conditions, to the suction of the condenser circulating pumps, and intake cooling water pumps. Refer to Figures 10.2-60 through 10.2-65 and 9.6-1 through 9.6-7.

Canal water flows into four separated screen wells through steel trash racks. The trash racks protect the traveling screens against damage from heavy debris. The water passes through traveling screens where the smaller debris is removed. The debris picked up by the screen is removed by water supplied by motor driven screen wash pumps, taking suction from the intake structure. Portable diesel-driven pumps, taking suction from the intake canal, may be used to backwash the screens when the motor-driven system is removed from service.

Water from each individual screen well flows to the suction of the motor driven, vertical, mixed flow circulating water pumps. Each of the four circulating water pumps provide a design flow of 156,250 GPM.

An on-line condenser cleaning system using sponge rubber balls is used to prevent scale build-up on condenser tubes, thus helping to maintain the thermal efficiency of the condenser.

The three intake cooling water pumps are also installed in the intake structure. Their capacity is 16,000 GPM each.

Turbine Controls

High pressure steam enters the turbine through the stop valves and governing control valves. Each stop valve is an oil operated, spring closing valve controlled primarily by the turbine over speed trip devices. The turbine overspeed trip pilot is actuated by one of the following to close the stop valves:

Turbine thrust bearing trip	Any generator fault
Low bearing oil pressure trip	Generator lockout
Low condenser vacuum	Hi-hi steam generator level
Solenoid trip	Safety injection signal
Overspeed trip	Reactor trip (above P-7)
Manual trip	

The hydraulically operated control valves of the plug type open and close in sequence to control steam admission to the turbine. They are actuated by the turbine speed governor which is responsive to turbine speed, and which includes:

A speed changer or synchronizing device

A load limit device which must be reset after operation of the overspeed trip before the control valves can be opened

An overspeed protection controller which senses a sudden loss of load and closes control and intercept valves

The governing emergency trip valve, actuated when the stop valves are tripped, to close the control valves

An auxiliary governor, responsive to the rate of turbine speed increase, to close the control valves

A motor operated pressure control valve is provided to enable the control valves and stop valves to be tested.

Test switches with indicating lights are provided on the control board turbine section. Removable strainers are located in each control valve body to protect the valves and turbine from foreign material in the steam. Temporary fine mesh strainers are installed during initial operation.

The reheat stop and interceptor valve assemblies are incorporated into the reheater piping to prevent overspeeding of the turbine by reheater steam. The interceptor valves are under governor control. On a load rejection, the interceptor valves and governor valves are closed rapidly.

The normal governing devices, which operate through hydraulic relays to operate the control valves, are as follows:

1. The governor handwheel at the unit;
2. The governor synchronizing motor, which is controlled by a switch on the electrical section of the control board and is used for raising or lowering turbine speed or load; and
3. The load limit motor, which is controlled by a switch on the turbine section of the control board.

The pre-emergency device functions similar to the normal governing devices by operating the control valves in case of abnormal operating conditions in the auxiliary governor. This pre-emergency device closes the control valves on rapid increase in turbine speed. The control valves will be actuated by either the speed governor or load limit, and the device delivering the lowest oil pressure will be in control. Pressure gauges on the control board indicate the oil pressure from these devices.

The emergency devices which will trip the stop valves, the control valves and the air relay dump valve are as follows:

1. Overspeed trip
2. Solenoid trip (also actuated from reactor trip, electrical faults, AMSAC signal, and a manual push button); Unit 3 has a backup turbine overspeed trip function based on main oil pump discharge pressure (refer to discussion below).
3. Low condenser vacuum trip
4. Low bearing oil pressure trip
5. Thrust bearing trip
6. Manual trip at unit

The mechanical overspeed trip mechanisms consist of an eccentric weight mounted in the end of the turbine shaft, which is balanced in position by a spring until the speed reaches approximately 108% of rated speed (the tripping speed). Its centrifugal force then overcomes the restraining spring and the eccentric weight flies out striking a trigger which trips the overspeed trip valve and releases the autostop fluid to drain. The resulting decrease in autostop pressure causes the governing emergency trip valve to release the control oil pressure, and this closes the main stop and governing valves. An air pilot-valve used to control the extraction non-return valves is also actuated from the autostop pressure.

The autostop valve is also tripped when any one of the protective devices is actuated. The protective devices include a low bearing oil pressure trip, a solenoid trip, a thrust bearing trip and a low vacuum trip. These devices are all included in a separate assembly, but connected hydraulically to the overspeed trip valve. An additional protective feature includes a turbine trip following a reactor trip.

A diverse backup turbine overspeed trip function is installed on Unit 3. The trip function senses main oil pump discharge high pressure and actuates both primary and backup autostop solenoid valves. This backup trip function is redundant to the speed control and overspeed protection functions and is not required to be in service at any time. A keylock switch allows this trip function to be disabled.

Trip of the turbine-generator initiates a reactor trip when power is greater than 10% to prevent excessive reactor coolant temperature and/or pressure.

10.2.3 SHIELDING

No radiation shielding will be required for the components of the steam and power conversion system. Continuous access to the components of this system will be possible during normal operation.

10.2.4 CORROSION PROTECTION

10.2.4.1 CHEMICAL ADDITION

Ammonium Hydroxide or an alternate amine is added to the condensate at the pump discharge to control pH. Hydrazine is also added to control oxygen.

10.2.4.2 CONDENSATE POLISHING DEMINERALIZER SYSTEM

A condensate polishing demineralizer system is provided to purify the condensate by filtration and demineralization to provide high quality condensate water to Turkey Point Units 3 and 4 steam generators and is shown on Figures 10.2-47 through 10.2-54. The condensate polishing demineralizer system is unitized, one for Unit 3 and one for Unit 4. The system is typically used during startup periods, and can accommodate full or partial condensate pump flow. The system is not normally used during power operation, to reduce the potential for feedwater transients, and enhance plant reliability.

When in use, the condensate polishing demineralizer system treats condensate flow discharged from the condensate pumps. The condensate polishing demineralizer system includes precoat and spent resin handling subsystems. The precoat subsystem is used to evenly distribute powdered resins across the resin retention elements within the filter/demineralizers. The spent resin handling subsystem is not utilized at Turkey Point. Resin slurry is delivered to the back wash reciever tank only. Water and spent resin disposal is accomplished under Chemistry and Health Physics supervision utilizing portable equipment as required.

As discussed in the following sections, the condensate polishing system is used in conjunction with the feedwater recirculation system, secondary system wet lay-up system, steam generator wet lay-up system, and steam generator blowdown recovery system to maintain proper water quality during various modes of plant operation.

10.2.4.3 STEAM GENERATOR BLOWDOWN RECOVERY SYSTEM

A steam generator blowdown recovery system is installed to assist in maintaining required steam generator water chemistry by providing a means for removal of foreign matter which concentrates in the evaporator section of the steam generator.

The steam generator blowdown recovery system is shown on Figures 10.2-41 and 10.2-42. The system is fed by three independent blowdown lines (one per steam generator) which tie into a common blowdown flash tank. The steam generator blowdown is continuously monitored for radioactivity during plant operation. A radiation monitor is provided for the steam generator blowdown sample lines in each unit. The isolation and control functions of this monitor are described in Section 11.2. The blowdown sample lines can be isolated using the manual isolation valves downstream of the motor operated isolation valves.

The Steam Generator Blowdown Isolation By-pass valves have their operators removed, and are maintained in a permanently closed position. This design maintains containment integrity and prevents a loss of steam generator inventory after an auxiliary feedwater system start. See Figures 10.2-41 and 10.2-42.

On-line Chemistry Monitoring instrumentation is connected to each blowdown sample line. The instrumentation provides a means by which the various levels of pH, cation conductivity, specific conductivity, dissolved oxygen, sodium, and chloride can be monitored (see Section 4.2.5).

Blowdown condensate from the flashtank is dumped to the discharge canal.

10.2.4.4 SECONDARY WET LAY-UP SYSTEM

A secondary wet lay-up system is provided to recirculate water through the condenser, condensate system, and feedwater system, including the shell side of the feedwater heaters, to prevent stratification and add chemicals to prevent any excursions of water quality in the secondary system during extended unit shutdowns. Maintaining a water solid condition during recirculation would minimize the presence of harmful gases to wetted surfaces. This system is shown on Figures 10.2-43 through 10.2-46.

The secondary system wet lay-up system consists of two closed loops which circulate the contents of the secondary system. Cleanup of the secondary system is provided through the condensate filter/demineralizers.

Chemicals are added to each loop via a common chemical feed pot.

10.2.4.5 STEAM GENERATOR WET LAYUP SYSTEM

A steam generator wet layup system is provided to recirculate water through the secondary side of the steam generators to prevent stratification and to provide a means for adding chemicals to prevent excursions of water quality in the steam generators during extended unit shutdowns (see Figures 10.2-55 and 10.2-56).

The steam generator wet layup system consists of three independent loops - one for each steam generator. The normal flow path in each loop is to take suction from the main feedwater line and return to the steam generator via the blowdown line. The flow may be reversed by changing the valve line up to take suction from the blowdown line and return to the steam generator via the feedwater line. The three loops are connected by a common header to provide versatility in the system. A chemical addition tank is common to all three loops. A nitrogen addition connection is included for maintaining a nitrogen blanket in the portion of the system not filled with water.

10.2.4.6 FEEDWATER RECIRCULATION SYSTEM

A feedwater recirculation system is provided to operate during normal plant shutdown or start-up to provide flow paths required to create a closed loop between the feedwater system and the condenser for wet layup and flushing of the secondary system (see Figures 10.2-15, 10.2-18, 10.2-23, and 10.2-26). The feedwater recirculation system may be operated in series with the condensate polishing demineralizer system. Circulation is provided by a condensate pump. Poor quality feedwater can be dumped from the feedwater recirculation line directly to the discharge canal.

10.2.5 RADIOACTIVITY

Under normal operating conditions, there are no radioactive contaminants present in the steam and power conversion system unless steam generator tube leaks develop. In this event, monitoring of the steam generator shell-side points, the air ejector condensers loop seal sample points and the air exhaust will detect any contamination and permit calculation of activity release to the atmosphere.

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-1

REFER TO ENGINEERING DRAWING

5613-M-3072 , SHEET 1

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

MAIN STEAM SYSTEM

FIGURE 10.2-1

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-2

REFER TO ENGINEERING DRAWING

5613-M-3072 , SHEET 2

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

MAIN STEAM SYSTEM

FIGURE 10.2-2

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-3

REFER TO ENGINEERING DRAWING

5613-M-3072 , SHEET 3

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY

TURKEY POINT PLANT UNIT 3

MAIN STEAM SYSTEM

MSIV CONTROL

FIGURE 10.2-3

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-4

REFER TO ENGINEERING DRAWING

5614-M-3072 , SHEET 1

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

MAIN STEAM SYSTEM

FIGURE 10.2-4

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-5

REFER TO ENGINEERING DRAWING

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REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY

TURKEY POINT PLANT UNIT 4

MAIN STEAM SYSTEM

FIGURE 10.2-5

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-6

REFER TO ENGINEERING DRAWING

5614-M-3072 , SHEET 3

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

MAIN STEAM SYSTEM
MSIV CONTROL

FIGURE 10.2-6

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-7

REFER TO ENGINEERING DRAWING

5613-M-3089 , SHEET 1

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

STEAM TURBINE SYSTEMS

FIGURE 10.2-7

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-8

REFER TO ENGINEERING DRAWING

5613-M-3089 , SHEET 2

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

STEAM TURBINE SYSTEMS

FIGURE 10.2-8

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-9

REFER TO ENGINEERING DRAWING

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REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY

TURKEY POINT PLANT UNIT 4

STEAM TURBINE SYSTEMS

FIGURE 10.2-9

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-10

REFER TO ENGINEERING DRAWING

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REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY

TURKEY POINT PLANT UNIT 4

STEAM TURBINE SYSTEMS

FIGURE 10.2-10

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-11

REFER TO ENGINEERING DRAWING

5613-M-3087 , SHEET 1

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY

TURKEY POINT PLANT UNIT 3

TURBINE LUBE OIL SYSTEM

LUBE & CONTROL OIL

RESERVOIR

FIGURE 10.2-11

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-12

REFER TO ENGINEERING DRAWING

5613-M-3087 , SHEET 2

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY

TURKEY POINT PLANT UNIT 3

TURBINE LUBE OIL SYSTEM

LUBE & CONTROL OIL

CONDITIONER

FIGURE 10.2-12

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-13

REFER TO ENGINEERING DRAWING

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FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

TURBINE LUBE OIL SYSTEM
LUBE & CONTROL OIL
RESERVOIR
FIGURE 10.2-13

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-14

REFER TO ENGINEERING DRAWING

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FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

TURBINE LUBE OIL SYSTEM
LUBE & CONTROL OIL
CONDITIONER
FIGURE 10.2-14

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-15

REFER TO ENGINEERING DRAWING

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FLORIDA POWER & LIGHT COMPANY

TURKEY POINT PLANT UNIT 3

CONDENSATE SYSTEM

FIGURE 10.2-15

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-16

REFER TO ENGINEERING DRAWING

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FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

CONDENSATE SYSTEM

FIGURE 10.2-16

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-17

REFER TO ENGINEERING DRAWING

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FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

CONDENSATE SYSTEM

FIGURE 10.2-17

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-18

REFER TO ENGINEERING DRAWING

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FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

CONDENSATE SYSTEM

FIGURE 10.2-18

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-19

REFER TO ENGINEERING DRAWING

5614-M-3073 , SHEET 2

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FLORIDA POWER & LIGHT COMPANY

TURKEY POINT PLANT UNIT 4

CONDENSATE SYSTEM

FIGURE 10.2-19

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-20

REFER TO ENGINEERING DRAWING

5614-M-3073 , SHEET 3

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FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

CONDENSATE SYSTEM

FIGURE 10.2-20

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-21

REFER TO ENGINEERING DRAWING

5610-M-3074 , SHEET 1

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY

TURKEY POINT PLANT UNITS 3 & 4

FEEDWATER SYSTEM
STANDBY STEAM GENERATOR
FEEDWATER PUMPS

FIGURE 10.2-21

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-22

REFER TO ENGINEERING DRAWING

5610-M-3074 , SHEET 2

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNITS 3 & 4

FEEDWATER SYSTEM
DEMINERALIZED STORAGE
AND DEAERATION
FIGURE 10.2-22

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-23

REFER TO ENGINEERING DRAWING

5613-M-3074 , SHEET 1

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FLORIDA POWER & LIGHT COMPANY

TURKEY POINT PLANT UNIT 3

FEEDWATER SYSTEM

FIGURE 10.2-23

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-24

REFER TO ENGINEERING DRAWING

5613-M-3074 , SHEET 2

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FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

FEEDWATER SYSTEM

FIGURE 10.2-24

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-25

REFER TO ENGINEERING DRAWING

5613-M-3074 , SHEET 3

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

FEEDWATER SYSTEM

FIGURE 10.2-25

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-26

REFER TO ENGINEERING DRAWING

5614-M-3074 , SHEET 1

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY

TURKEY POINT PLANT UNIT 4

FEEDWATER SYSTEM

FIGURE 10.2-26

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-27

REFER TO ENGINEERING DRAWING

5614-M-3074 , SHEET 2

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

FEEDWATER SYSTEM

FIGURE 10.2-27

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-28

REFER TO ENGINEERING DRAWING

5614-M-3074 , SHEET 3

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

FEEDWATER SYSTEM

FIGURE 10.2-28

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-29

REFER TO ENGINEERING DRAWING

5613-M-3081 , SHEET 1

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

FEEDWATER SYSTEM
FEEDWATER HEATER VENTS & DRAINS

FIGURE 10.2-29

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-30

REFER TO ENGINEERING DRAWING

5613-M-3081 , SHEET 2

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY

TURKEY POINT PLANT UNIT 3

FEEDWATER SYSTEM

FEEDWATER HEATER VENTS & DRAINS

FIGURE 10.2-30

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-31

REFER TO ENGINEERING DRAWING

5613-M-3081 , SHEET 3

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

FEEDWATER SYSTEM
FEEDWATER HEATER VENTS & DRAINS

FIGURE 10.2-31

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-32

REFER TO ENGINEERING DRAWING

5613-M-3081 , SHEET 4

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

FEEDWATER SYSTEM
FEEDWATER HEATER VENTS & DRAINS

FIGURE 10.2-32

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-33

REFER TO ENGINEERING DRAWING

5613-M-3081 , SHEET 5

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

FEEDWATER SYSTEM
FEEDWATER HEATER VENTS & DRAINS

FIGURE 10.2-33

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-34

REFER TO ENGINEERING DRAWING

5613-M-3081 , SHEET 6

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY

TURKEY POINT PLANT UNIT 3

FEEDWATER SYSTEM

FEEDWATER HEATER VENTS & DRAINS

FIGURE 10.2-34

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-35

REFER TO ENGINEERING DRAWING

5614-M-3081 , SHEET 1

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY

TURKEY POINT PLANT UNIT 4

FEEDWATER SYSTEM

FEEDWATER HEATER VENTS & DRAINS

FIGURE 10.2-35

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-36

REFER TO ENGINEERING DRAWING

5614-M-3081 , SHEET 2

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY

TURKEY POINT PLANT UNIT 4

FEEDWATER SYSTEM

FEEDWATER HEATER VENTS & DRAINS

FIGURE 10.2-36

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-37

REFER TO ENGINEERING DRAWING

5614-M-3081 , SHEET 3

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

FEEDWATER SYSTEM
FEEDWATER HEATER VENTS & DRAINS

FIGURE 10.2-37

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-38

REFER TO ENGINEERING DRAWING

5614-M-3081 , SHEET 4

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

FEEDWATER SYSTEM
FEEDWATER HEATER VENTS & DRAINS

FIGURE 10.2-38

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-39

REFER TO ENGINEERING DRAWING

5614-M-3081 , SHEET 5

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

FEEDWATER SYSTEM
FEEDWATER HEATER VENTS & DRAINS

FIGURE 10.2-39

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-40

REFER TO ENGINEERING DRAWING

5614-M-3081 , SHEET 6

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

FEEDWATER SYSTEM
FEEDWATER HEATER VENTS & DRAINS

FIGURE 10.2-40

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-41

REFER TO ENGINEERING DRAWING

5613-M-3074 , SHEET 4

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

FEEDWATER SYSTEM
STEAM GENERATOR BLOWDOWN
RECOVERY
FIGURE 10.2-41

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-42

REFER TO ENGINEERING DRAWING

5614-M-3074 , SHEET 4

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

FEEDWATER SYSTEM
STEAM GENERATOR BLOWDOWN
RECOVERY
FIGURE 10.2-42

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-43

REFER TO ENGINEERING DRAWING

5613-M-3082 , SHEET 1

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY

TURKEY POINT PLANT UNIT 3

SECONDARY SYSTEM

WET LAYUP SYSTEM

LOOP 1

FIGURE 10.2-43

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-44

REFER TO ENGINEERING DRAWING

5613-M-3082 , SHEET 2

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY

TURKEY POINT PLANT UNIT 3

SECONDARY SYSTEM

WET LAYUP SYSTEM

LOOP 2

FIGURE 10.2-44

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-45

REFER TO ENGINEERING DRAWING

5614-M-3082 , SHEET 1

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY **TURKEY POINT PLANT UNIT 4**
SECONDARY SYSTEM WET LAYUP SYSTEM LOOP 1 **FIGURE 10.2-45**

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-46

REFER TO ENGINEERING DRAWING

5614-M-3082 , SHEET 2

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

SECONDARY SYSTEM
WET LAYUP SYSTEM
LOOP 2
FIGURE 10.2-46

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-47

REFER TO ENGINEERING DRAWING

5613-M-3077 , SHEET 1

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY

TURKEY POINT PLANT UNIT 3

CONDENSATE POLISHING SYSTEM
DEMINERALIZER

FIGURE 10.2-47

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-48

REFER TO ENGINEERING DRAWING

5613-M-3077 , SHEET 2

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

CONDENSATE POLISHING SYSTEM
DEMINERALIZER

FIGURE 10.2-48

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-49

REFER TO ENGINEERING DRAWING

5613-M-3077 , SHEET 3

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

CONDENSATE POLISHING SYSTEM
SPENT RESIN HANDLING SUBSYSTEM

FIGURE 10.2-49

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-50

REFER TO ENGINEERING DRAWING

5613-M-3077 , SHEET 4

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY

TURKEY POINT PLANT UNIT 3

CONDENSATE POLISHING SYSTEM
EFFLUENT SAMPLING

FIGURE 10.2-50

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-51

REFER TO ENGINEERING DRAWING

5614-M-3077 , SHEET 1

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

CONDENSATE POLISHING SYSTEM
DEMINERALIZER

FIGURE 10.2-51

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-52

REFER TO ENGINEERING DRAWING

5614-M-3077 , SHEET 2

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

CONDENSATE POLISHING SYSTEM
DEMINERALIZER

FIGURE 10.2-52

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-53

REFER TO ENGINEERING DRAWING

5614-M-3077 , SHEET 3

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

CONDENSATE POLISHING SYSTEM
SPENT RESIN HANDLING SUBSYSTEM

FIGURE 10.2-53

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-54

REFER TO ENGINEERING DRAWING

5614-M-3077 , SHEET 4

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

CONDENSATE POLISHING SYSTEM
EFFLUENT SAMPLING

FIGURE 10.2-54

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-55

REFER TO ENGINEERING DRAWING

5613-M-3078 , SHEET 1

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

STEAM GENERATOR
WET LAYUP SYSTEM

FIGURE 10.2-55

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-56

REFER TO ENGINEERING DRAWING

5614-M-3078 , SHEET 1

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY

TURKEY POINT PLANT UNIT 4

STEAM GENERATOR

WET LAYUP SYSTEM

FIGURE 10.2-56

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-57

REFER TO ENGINEERING DRAWING

5610-M-3065 , SHEET 2

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNITS 3 & 4

NITROGEN & HYDROGEN SYSTEMS
NITROGEN CAP SYSTEM

FIGURE 10.2-57

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-58

REFER TO ENGINEERING DRAWING

5613-M-3014 , SHEET 3

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY

TURKEY POINT PLANT UNIT 3

CONDENSER SYSTEM

FIGURE 10.2-58

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-59

REFER TO ENGINEERING DRAWING

5614-M-3014 , SHEET 3

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

CONDENSER SYSTEM

FIGURE 10.2-59

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-60

REFER TO ENGINEERING DRAWING

5613-M-3010 , SHEET 1

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

CIRCULATING WATER SYSTEM

FIGURE 10.2-60

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-61

REFER TO ENGINEERING DRAWING

5613-M-3010 , SHEET 2

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 3

CIRCULATING WATER SYSTEM
CONDENSER WATER BOX PRIMING

FIGURE 10.2-61

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-62

REFER TO ENGINEERING DRAWING

5613-M-3010 , SHEET 3

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY

TURKEY POINT PLANT UNIT 3

CIRCULATING WATER SYSTEM
LUBE WATER TO CIRCULATING
WATER PUMPS

FIGURE 10.2-62

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-63

REFER TO ENGINEERING DRAWING

5614-M-3010 , SHEET 1

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

CIRCULATING WATER SYSTEM

FIGURE 10.2-63

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-64

REFER TO ENGINEERING DRAWING

5614-M-3010 , SHEET 2

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY

TURKEY POINT PLANT UNIT 4

CIRCULATING WATER SYSTEM

CONDENSER WATER BOX PRIMING

FIGURE 10.2-64

FINAL SAFETY ANALYSIS REPORT

FIGURE 10.2-65

REFER TO ENGINEERING DRAWING

5614-M-3010 , SHEET 3

REV. 13 (10/96)

FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT UNIT 4

CIRCULATING WATER SYSTEM
LUBE WATER TO CIRCULATING
WATER PUMPS
FIGURE 10.2-65

10.3 SYSTEM EVALUATION

10.3.1 SAFETY FEATURES

Variable Limit Functions

Trips, automatic control actions and alarms will be initiated by deviations of system variables within the steam and power conversion system. In the case of automatic corrective action in the steam and power conversion system, appropriate corrective action will be taken to protect the reactor coolant system. The more significant malfunctions or faults which cause trips, automatic actions or alarms in the steam and power conversion system are:

(a) Turbine Trips

1. Generator/electrical faults
2. Lower condenser vacuum
3. Thrust bearing failure
4. Low lubricating oil pressure
5. Turbine overspeed
6. Reactor trip
7. Manual trip

(b) Automatic Control Actions

1. Water level in each steam generator is controlled by a three-element feedwater regulator incorporating signals from water level, steam flow and water flow.

2. The steam bypass to the condenser is initiated by an average temperature value of the reactor coolant at the inlet and outlet of the steam generators.

(c) Principal Alarms

1. Low pressure at feedwater pump suction
2. Low vacuum in condenser
3. High or low water level in condenser hotwell
4. High temperature in LP exhaust hood
5. Turbine supervisory instrument signal

Transient Effects

A reactor trip from power requires subsequent removal of core decay heat. Core decay heat can be continuously dissipated via the steam bypass to the condenser as feedwater in the steam generator is converted to steam by heat absorption. Normally, the capability to return feedwater flow to the steam generators is provided by operation of the turbine cycle feedwater system.

In the unlikely event of complete loss of electrical power to the station, decay heat removal would continue to be assured by the availability of three steam-driven, auxiliary feedwater pumps, and steam discharge to atmosphere via the main steam safety valves and main steam dump to atmosphere (SDTA) valves. In this case feedwater is available from the condensate storage tank by gravity feed to the auxiliary feedwater pumps as described in Section 9.11.

The analysis of the effects of loss of full load on the reactor coolant system is discussed in 14.1.10. Analysis of the effects of partial loss of load on the reactor coolant system is discussed in Section 7.3.

10.3.2 SECONDARY-PRIMARY INTERACTIONS

Following a turbine trip, the control system reduces reactor power output immediately by a reactor trip.

In the event of failure of one feedwater pump the feedwater pump remaining in service will carry approximately 60 percent of full load feedwater flow. If both normal feedwater pumps fail, the turbine will be tripped, and the emergency feedwater pumps will start automatically.

10.3.3 PRESSURE RELIEF

Pressure relief is required at the system design pressure of 1085 psig, and the first safety valve is set to relieve at this pressure. Additional safety valves are set at pressures up to 1130 psig. The code allows a 1% tolerance on the safety valve setpoint. Manual means are provided for operating the 10% steam dump to atmosphere. The SDTA valves are designed to operate in the unlikely event of complete loss of electrical power and/or instrument air.

The pressure relief capacity is equal to the steam generation rate of maximum calculated conditions.

10.3.4 SYSTEM INCIDENT POTENTIAL

The evaluation of the capability to isolate a steam generator to limit the loss of radioactivity is presented in Section 14.2.4. The steam line break accident analysis is presented in detail in Section 14.2.5.

10.4 TEST AND INSPECTIONS

The main steam isolation valves shall be tested at refueling intervals. Closure time shall be verified.

On a monthly basis, the auxiliary feedwater pumps will be operated to verify their operability. The auxiliary feedwater system is tested in accordance with Plant Technical Specifications and inservice testing procedures.

Proper functioning of the steam admission valve and subsequent pump start will demonstrate the integrity of the system. Verification of correct operation will be made both from instrumentation within the control room and direct visual observation of the pump.